

## Science Corner: Atmospheric Optics

By Peter Mohlin - Meteorologist

While many of you may be familiar with the various different types of clouds, when conditions are just right, there are other phenomena that can occur in the sky. Some of them are fairly common, while others might only be seen once or twice in a lifetime at best. Collectively, anything having to do with light and color in the atmosphere and usually produced by water droplets, ice crystals and/or dust are called atmospheric optics.

The most recognizable atmospheric optic is probably the rainbow, which most of you have likely seen at least once, perhaps even on multiple occasions. However, there are several other visual spectacles that are less familiar, and all of which occur through 4 different methods: reflection, refraction, scattering and/or diffraction of light. If you ever saw something in the sky that looked strange, yet magnificent or beautiful, you might have been looking at some type of atmospheric optic.

Next we will briefly discuss several different types of atmospheric optics, indicating how they form and showing a photo of each.



© 2006, Jerry W. Kinnamon

### Circumzenithal Arc

The Circumzenithal Arc, also called the Bravais' Arc or "a smile in the sky" is similar to a rainbow, but develops through the refraction of sunlight through one side and one face of horizontally oriented ice crystals. It is generally observed in Cirrus clouds, and its colors are similar to a rainbow, ranging from violet on the inside to red on the outside.



### Belt of Venus

The Belt of Venus, also called the Anti-Twilight Arch or Venus's Girdle is visible many times just before sunrise or just after sunset, and occurs just above the horizon in the direction opposite the sun. It is slightly off-color, pinkish to brownish border separating the dark shadow band of the earth from the sky above. While the blue sky is normal sunlight reflecting off the atmosphere, in the Belt of Venus there is backscattering of reddish light from the setting or rising sun. It is best visible when the sky is clear, yet dusty and extends approximately 10 to 20 degrees above the horizon.



### Corona

Although similar in appearance to a Halo, the Corona is formed by the diffraction of light passing through clouds containing small water droplets of a fairly uniform size. They occur with Altocumulus and Altostratus clouds and are seen as a white or colored circle, or a set of concentric circles of light visible around the sun or the moon. Their occurrence can also be an indication of precipitation arriving at your location within 6 to 12 hours.

**Science Corner: Atmospheric Optics Continued...**(c), Copyright 2008, Douglas Berry**Crepuscular Rays**

Crepuscular Rays, also called Shadow Bands, Solar Rays or Sunrays, are usually produced by an obstruction to sunlight. The obstruction can be caused by Cumuliform clouds, dust or other particles in the atmosphere where the light becomes scattered. The rays are parallel to each other and their source can be traced back to the sun.

**Anti- crepuscular Rays**

Anti-Crepuscular rays are much like Crepuscular Rays, except they are bands of light or shadows that are observed on the opposite horizon from where the sun is found.

**Glory**

A Glory is produced by light that is backscattered (a combination of diffraction, reflection and refraction) towards its source by a cloud of uniformly sized water droplets. The phenomenon appears much like the halo of a saint, can have multiple colored rings and can fluctuate greatly in their size. However, most people only see one ring and they are usually only visible from an airplane or on a mountaintop, where the clouds are below your point of view and you are located between the sun and the clouds. They are sometimes called an Anticorona or a Broken Bow.

(c), Copyright 2008, Douglas Berry**Halo**

A Halo is usually a bright circle centered on the sun or moon, but can be a variety of bright circles or arcs. The Halo results from the refraction of light by ice crystals that are suspended in the atmosphere and exhibits a prismatic coloration ranging from red on the inside to blue on the outside. They most commonly occur with Cirrostratus clouds and can be used to predict the weather. If they are seen with these clouds it is often an indicator that precipitation will occur within 12 to 24 hours.

## Science Corner: Atmospheric Optics Continued...



### Iridescence

These are brilliant spots or borders of colors in clouds, usually red and green, caused by diffraction of light by small cloud particles. This phenomenon is usually observed in Cirrus or Cirrocumulus clouds within about 30 degrees of the sun and is characterized by bands of color in the cloud that contour the cloud edges. The Iridescence is sometimes referred to as Irisation.



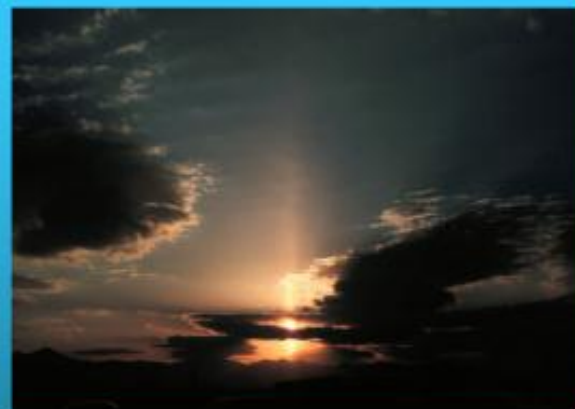
### Parhelion

Parhelion is the scientific name for Sun Dogs, and is also known as Parhelia and Mock Suns. They appear as luminous spots at the same elevation and roughly 22 degrees to the right and left of the sun. They result from the refraction of sunlight passing through ice crystals. At times however, only one Parhelion or Sun Dog will be visible dependent upon the cloud cover, and they are exclusively associated with Cirriform clouds.



### Secondary Rainbow

Rainbows are caused by the refraction, total reflection and scattering of light, and are always observed in the opposite direction from the sun. While a single or primary Rainbow features all the colors of the spectrum from violet on the inside to red on the outside, the secondary Rainbow shows these same colors, but in reverse order. The secondary Rainbow is about 10 degrees further out from the primary Rainbow, and is about twice as wide. The light of the secondary Rainbow is much less intense than that of the primary bow, given the same viewing conditions. A third or tertiary Rainbow, and higher order rainbows are also possible, but due to their low luminosity are rarely seen. If they do occur they are found on the same side as the sun, making them much more difficult to see.



### Sun Pillar

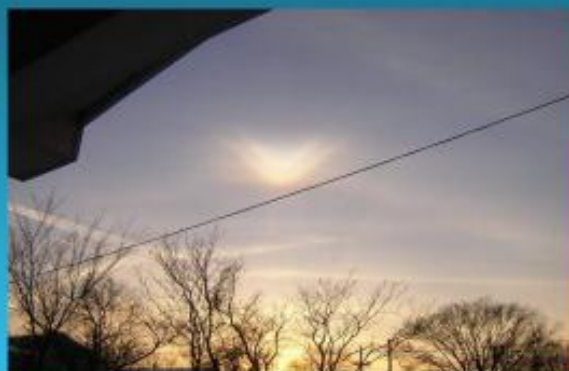
This phenomenon is also called a Sub-Sun or a Light Pillar, and is caused by the reflection of light off the surfaces of falling ice crystals that are associated with Cirriform clouds. The Sun Pillar is a vertical shaft of light extending upward or downward from the sun, usually when the sun is low in the horizon.

## Science Corner: Atmospheric Optics Continued...



### Green Flash

The Green Flash results from the refraction of light. It is also called a Blue Flash, a Blue-Green Flame and a Green Segment. Light moves slower in the lower and denser air near the earth's surface than in the thinner air above, so the sunlight will follow paths that curve slightly in the same direction as the curvature of the earth. The higher frequency green and blue light will curve more than the lower frequency red and orange light, so the blue and green rays from the upper edge of the setting sun will remain visible after the red and orange rays are obstructed by the curvature of the earth. The Green Flash is only visible for about a second and they are best seen on an unobstructed view of the horizon. If you are fortunate enough to witness its occurrence, it is said to bring you good luck.



### Tangent Arc

The Tangent Arc is caused by the refraction of light above and below the sun, through horizontally oriented ice crystal columns. It is similar to a Halo, but it appears over and tangent to the Halo around the sun. The shape of the arc will vary with the elevation of the sun, with the arc forming a sharp angle when the sun is low in the sky. Like other Halos the Tangent Arc is red on the inner edge and blue on the outer edge because the red light is refracted more than the blue light.

## Using Skype To Communicate with T.V. Media Partners

By Ron Morales - Warning Coordination Meteorologist



Our local T.V. media partners have expressed a strong interest in using Skype for live, video interviews. If you are not familiar with Skype, it allows you to have live video phone conversations with anyone else that has the software loaded on their PC, laptop or even smart phone. The software is available for download free on the web ([www.skype.com](http://www.skype.com)).

In the near future, you will likely see some of the faces of the National Weather Service Forecast Office in Charleston on your local T.V. weather broadcast, especially during severe or unusual weather events.

